3 Workshop Results

This section provides information derived from the results of the eight workshops. Exploration needs categories are provided that have been consolidated and standardized from the raw workshop data. Categorized exploration needs resulting from each workshop are listed and include descriptive information, candidate locations for exploration, enabling technologies, and potential partners. Charts showing the general location of candidate exploration targets also accompany these data.

3.1 Exploration Needs Categories

The results from the workshop needs identification and exploration approach phases represent contributions from participants totaling over 300 person-days of effort. A suitable organization of this large amount of information was required in order to provide a means for analyzing and using the collected data. Additionally, these data covered a wide range of disciplines. Subject matter included all fields of oceanography and other areas related to geology, biology, chemistry, and archeology. Technologies from basic mechanical equipment to complex instrumentation were also discussed. The geographic distribution of the workshops and the broad scope of scientific expertise in attendance led to a large number of diverse exploration initiatives.

To provide the necessary organization, data were summarized by dividing the information into exploration needs categories based upon dominant subjects within the information. These categories are listed alphabetically in Table 3-1 with an accompanying definition for each category. They are used throughout this report as an organizational basis for the workshop results and have not been subjected to any prioritization scheme. The volume of ocean exploration needs described by each category varies significantly from category to category. An emphasis on the exploration of unique environments and the constituents within those environments is evident in the list of categories, illustrated by the variety of marine ecosystems included as individual items.

Table 3-1. Exploration Needs Categories

Need Category	Definition
Archeology	Exploration of submerged material remains represented by fossils, relics, wrecks, remains, and artifacts in the study of humans and their history, heritage, activities, or impacts
Artificial Habitats	Man-made objects that intentionally or serendipitously serve as habitats for marine biota
Benthic Environment	The ocean bottom and sub-bottom including permanent communities of organisms and their interactions
Boundary Fluxes - Air/Sea	The exchange of energy and matter between the air and sea environments
Boundary Fluxes - Basins	The exchange of energy and matter between the bottom boundary of the ocean and the overlying waters
Corals - Deep Water	Corals and coral reefs located below 200 meters depth
Corals - Shallow Water	Corals and coral reefs located above 200 meters depth
Currents & Water Masses	The advection and convection of the ocean, its physical properties, and its effects on water masses, boundaries, ecosystems, and biotic and abiotic constituents
Ecosystems - General	Interactions of all organisms with and within their environments, including the inventory and mapping of these constituents and their environments
Ecosystems - Abrupt Topography (subcategories listed below)	Ecosystems influenced by rapidly changing and variable geomorphologic features
Arcs	The long broad elevation that rises from the sea floor around ocean basins
Canyons	A submarine valley with relatively steep slopes and progressive deepening in a direction away from shore
Channels / Straits	A waterway or strip of water that connects two larger bodies of water
Fjords	A narrow steep inlet from the sea excavated by glaciation
Glacier tongues	The projection of a glacier seaward, usually afloat
Karst / Ring Depressions	Areas of characterized by ravines, sinks, caverns and depressions possibly arising from underground streams and currents
Seamounts/Ridges	Unusually pronounced elevation rising 900 meters or more from the ocean bottom
Trenches	A long, narrow, and steep seafloor depression
Ecosystem - Banks & Basins	Ecosystems on or near the ocean floor that are at a depth greater than 2000 meters
Ecosystem - Extreme Environments - Sea Ice	Ecosystems in the marginal ice zone, under sea ice, and adjoining high-latitude waters
Ecosystem - Extreme Environments - Vents, Seeps & Volcanoes	Ecosystems near geologically active bottom features that are characterized by immoderate, intense physical, chemical, biological, and geological conditions
Ecosystem - Caves	Ecosystems in enclosed, confined underwater areas
Ecosystem - Lakes	Ecosystems in freshwater lakes
Ecosystem - Shoreline to Ledges	Ecosystems located in the regions between the coast and the edge of the continental shelf

Need Category	Definition
Ecosystem - Slopes	Ecosystems located in the regions between ocean basins and the continental shelf
Episodic Events	Significant events of regular or irregular temporal frequency occurring in the ocean and inland seas
Geology & Geomorphology	Composition of the ocean bottom, sub-bottom, and the nature and history of the landforms on the ocean bottom and the processes that create them
High Resolution Bathymetry	Mapping of the bottom boundary of the ocean to resolutions on the order of 1 meter in the horizontal and 0.01 meter in the vertical
Human Impacts	Influences and impacts on the ocean environment from humans and human activity
Marine Conservation	The management of marine resources and the identification of candidate areas for regulation and protection
Marine Microorganisms	Marine viruses, bacteria, microplankton, and other biota of a microbial spatial scale and their interactions with the environment
Marine Organisms	Macro-scale marine biota and their biological processes within the context of their natural environment
Ocean Resources - Bioprospecting	The search for valuable chemical compounds and genetic material from oceanic plants, animals and microorganisms
Ocean Resources - Energy & Minerals	Nonliving natural resources in the ocean, including materials that may be exploitable for energy production and those that have significant commercial value
Pelagic Environment	The open ocean environment, its constituents, and the interactions between these constituents and their surroundings
Sound in the Ocean	The application of acoustics to observe the ocean and its inhabitants, including the passive monitoring of biotic, geophysical, or other activity and the active generation and reception of acoustic energy from oceanographic sensors and systems

3.2 Common Approaches

The second phase of the workshop process applied a methodology to collect information on the assets and technologies needed and to add a sense of deliberate process as to how exploration activities would be accomplished. These discussions among the workshop participants allowed the sharing of ideas on how to approach exploration missions, which approaches were most appropriate for certain needs categories, and which assets would be needed to satisfy the identified exploration needs.

A summary of the exploration approaches resulting from these discussions appears in Table 3.2. These approaches and their descriptions were applied to the applicable needs categories during the second phase of the workshops resulting in a clearer definition of the capital assets and related technologies required to satisfy each needs. A discussion of the needs for associated assets and technologies is included in Section 4 of this report.

Table 3-2. Summary of Exploration Approaches

Exploration of Environments		
Approach Name	Approach Description	Applicable Needs Categories
Funnel	A broad-based exploration "survey" of an area of interest, with the resulting data allowing multidisciplinary exploration of increasingly detailed targets within that area	All Categories
Targeted	Use existing data to select specific exploration targets for multidisciplinary explorations	All Categories
Exploration of Dynamic Phenomena		
Approach Name	Approach Description	Applicable Categories
Fixed Position Observation	Use various tools to monitor a fixed exploration area for a designated period of time	Boundary Fluxes - Air/Sea; Boundary Fluxes - Basins; Currents & Water Masses; Ecosystems; Episodic Events; Geology & Geomorphology; Human Impacts; Marine Microorganisms; Marine Organisms; Sound in the Ocean
Mobile Observation	Use of various tools to monitor an area that changes over time. The area of observation changes both passively and actively in response to set of stimuli. Examples of passive response include a drifter in the current or a Critter Cam. Examples of active response include an AUV actively following biota or monitoring the ocean during a hurricane	Boundary Fluxes - Air/Sea; Boundary Fluxes - Basins; Currents & Water Masses; Episodic Events; Geology & Geomorphology; Human Impacts; Marine Microorganisms; Marine Organisms; Sound in the Ocean

3.3 Regional Results

This section provides results from each of the eight regional workshops identified in Table 2-1. The results for each region include a brief summary highlighting unique perspective from that workshop, a table of categorized exploration needs, and charts that display the location of candidate exploration targets identified by workshop participants.

The data in each table are sorted by the exploration needs categories identified in Table 3-1 to enhance their utility. Listed exploration needs and gaps may represent duplicate or similar items generated by breakout groups during the workshops that were combined during analysis. Every attempt was made to preserve the original intent or objective of the participants.

Enabling technology and partnership data incorporate the terminologies of a "standard package" and "standard partners." These descriptions were developed during the conduct of the workshops and were adopted by facilitators and participants as a mechanism to same time. As data were being gathered, it became clear that many of the exploration needs required the application of similar platforms and suites of equipment in order to satisfy those needs. For example, a standard package might consist of a Class I or II surface vessel with high-resolution acoustic mapping capability, a deep-diving capability (ROV, AUV, or submersible) with imagery/video, sampling, and precise positioning equipment, and education and outreach components. The standard partners descriptor represents groups of regional entities nominated by workshop participants as probable partners and collaborators across many of the regional exploration needs. Each of the tables in this section includes a leading row defining the composition of the standard packages and partners for that region.[6]

The column headings for each of these tables meet the following definitions:

- *ID* – A numeric identifier assigned to the original data, used for tracking and control of individual line items during analysis, and maintained to support further cross referencing
- *Category* – The exploration needs categories presented in Table 3-1
- *Information Need/Gap* – Exploration needs identified by the workshop participants
- *What* – Amplifying descriptive information for the associated exploration need provided by workshop participants
- *Where* – Candidate target areas or sites identified by participants for application of exploration approaches to satisfy the regional needs; identifiable sites within these data are represented on accompanying charts
- *Enabling Technologies* – Application of approaches and desired technologies identified by participants as important contributors to satisfying related exploration needs

- *Partners* – Entities and organizations identified by participants as likely collaborators

The charts that accompany each region's information provide a geographical reference to exploration targets of interest that were identified by workshop participants. These charts are not intended to be an inclusive representation of *all* potential exploration targets of interest in each region, but represent only those locations identified by workshop participants as desired exploration sites. The reader must also recognize that there are a large number of broad, unspecific targets of interest identified by the participants that are not appropriate for inclusion in these charts. Examples include areas such as coastal regions, warm water environments, the deep benthos, and migration routes.